IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPEAL BRIEF FOR THE APPELLANT

Ex parte Jianzhong ZHANG, *et al.*

APPARATUS, AND ASSOCIATED METHOD, FOR A MULTIPLE-INPUT, MULTIPLE-OUTPUT COMMUNICATION SYSTEM

Serial No. 10/080,933
Confirmation No. 6502
Appeal No.: TBD
Group Art Unit: 2611

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In re the Appellant:

Jianzhong ZHANG, *et al.*

Appeal No.: TBD

Serial Number: 10/080,933

Group Art Unit: 2611

Filed: February 22, 2002
Confirmation No. 6502

Examiner: Jean B. Corrielus

For: APPARATUS, AND ASSOCIATED METHOD, FOR A MULTIPLE-INPUT, MULTIPLE-OUTPUT COMMUNICATION SYSTEM

BRIEF ON APPEAL

June 21, 2010

I. INTRODUCTION

This is an appeal from the final rejections set forth in an Official Action dated February 16, 2010, finally rejecting claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47, all of the claims pending in this application. The Office Action objected to claims 26, 28, and 36 because of minor informalities. Claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum. Claims 27 and 37 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum, and further in view of Taylor.

A Request for Reconsideration ("Response") was timely filed on April 2, 2010. Claims 26, 28, and 36 were amended in the Response. An Advisory Action was issued on

April 9, 2010, indicating that the Response had been considered, but did not place the application in condition for allowance. The Advisory Action also indicated that the claim amendments included in the Response were to be entered for purposes of appeal, and thus the objections to claims 26, 28, and 36 were withdrawn. Claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47 remain rejected.

A Notice of Appeal and a Pre-Appeal Brief Request for Review were timely filed on May 11, 2010. A Notice of Panel Decision from Pre-Appeal Brief Review was issued on June 1, 2010, indicating that the rejections of claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47 were maintained. Accordingly, this Appeal Brief is being timely filed within one month of the Notice of Panel Decision.

II. REAL PARTY IN INTEREST

The real party in interest in this application is Nokia Corporation of Espoo, Finland, by virtue of an Assignment by the inventors, which assignment was recorded at Reel 012650, Frame 0040, on February 22, 2002.

III. STATEMENT OF RELATED APPEALS AND INTERFERENCES

There are no known related appeals and/or interferences which will directly effect or be directly effected by or have a bearing on the Board's decision in this appeal.

IV. STATUS OF CLAIMS

Claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47, all of the claims pending in the present application are the subject of this appeal. Claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum. Claims 27 and 37 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum, and further in view of Taylor.

V. STATUS OF AMENDMENTS

Appellant filed a Response on April 2, 2010, amending claims 26, 28, and 36, to overcome the claim objections presented in the Office Action dated February 16, 2010. The Advisory Action dated April 9, 2010, indicated that the claim amendments had been entered for purposes of appeal, and further indicated that the objections to claims 26, 28, and 36 had been withdrawn. The claims, as amended, are shown in the appropriate appendix to this brief.

VI. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 21, upon which claims 23-28, 30-31, 46, and 47 depend, recites an apparatus. The apparatus includes a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system, and a signal estimator configured to estimate channel operations of the signal from the signal filter (*see* specification, at least, at page 11, lines 5-11). The apparatus also includes a signal optimizer configured to generate optimized values for the signal from the signal filter, a prefilter configured to filter the signal from the signal filter using the generated optimized values for the signal, and a decision feedback sequence estimator configured to receive the generated optimized values (*see* specification, at least, at page 13, lines 1-17). The decision feedback sequence estimator includes a summing element, a feedback filter, and a maximum likelihood sequence estimator (*see* specification, at least, at page 13, line 9, to page 14, line 15). The summing element, the feedback filter, and the maximum likelihood sequence estimator are operatively connected to one another and further operatively connected to the prefilter (*see* specification, at least, at page 13, line 9, to page 14, line 15). An interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system (*see* specification, at least, at page 15, line 7, to page 18, line 16).

Claim 32, upon which claims 33, 36, and 37 depend, recites a method. The method

includes receiving a data vector at a receiving station of a multiple-input, multiple-output system, forming optimized feed forward filter parameters from the data vector, and forming optimized feedback filter parameters from the data vector (*see* specification, at least, at page 11, lines 5-11, and page 13, lines 1-8). The method further includes transmitting the optimized feed forward filter parameters and the optimized feedback filter parameters to a decision feedback sequence estimator (*see* specification, at least, at page 13, line 9). The decision feedback sequence estimator includes a feedback filter (*see* specification, at least, at page 13, lines 10-11). Further, the method includes applying the optimized feed forward filter parameters to a feed forward filter to define filter characteristics of the feed forward filter, and applying the optimized feedback filter parameters to the feedback filter to define filter characteristics of the feedback filter (*see* specification, at least, at page 15, line 7, to page 18, line 16). The method also includes simultaneously performing interference cancellation and pre-filtering operations on the data vector through operation of the feed forward and feedback filters (*see* specification, at least, at page 15, line 7, to page 18, line 16). Receiving the data vector includes receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system (*see* specification, at least, at page 15, line 7, to page 18, line 16).

Claim 38, upon which claims 40-42 depend, recites an apparatus. The apparatus includes signal filtering means for filtering a signal from a signal receiver of a multiple-input, multiple-output system, and signal estimating means for estimating channel operations of the signal from the signal filter means (*see* specification, at least, at page 11,

lines 5-11). The apparatus also includes signal optimizing means for generating optimized values for the signal from the signal filtering means, prefiltering means for filtering the signal from the signal filtering means using the generated optimized values for the signal and interference cancelling means for receiving the generated optimized values to perform concurrent interference and prefilter operations *see* specification, at least, at page 13, lines 1-17, and page 13, line 9, to page 14, line 15). The interference cancelling means includes pre-filtering means, summing means for summing inputs from the prefilter means, feedback filtering means for filtering optimized values and a summed output from the signal optimizing means and the summing means, respectively, and maximum likelihood sequence estimating means for generating maximum-likelihood values from the summing means (*see* specification, at least, at page 13, line 9, to page 14, line 15). An interconnection of the pre-filtering means, the feedback filtering means, the maximum likelihood sequence estimating means, and the summing means in the apparatus is configured to permit the concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system (*see* specification, at least, at page 15, line 7, to page 18, line 16).

VII. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum. Claims 27 and 37 were rejected under 35 U.S.C. §103(a) as being allegedly unpatentable as obvious over Zangi in view of Ketchum, and further in view of Taylor. These rejections are the subject of this appeal.

VIII. APPELLANT'S ARGUMENTS

Appellant respectfully submits that each of pending claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47 recites subject matter that is not taught, disclosed, or suggested by the cited prior art. Consequently, although some of the arguments presented below are broadly presented, each of the claims is being argued separately under a separate sub-heading as suggested by 37 C.F.R. §41.37(c)(1)(vii), and thus each of the claims stands or falls alone. It is respectfully submitted, however, that in the case of each claim, the Office Action has failed to demonstrate that the features recited in the pending claims are obvious to one of ordinary skill in the relevant art based on the references presented in the Office Action.

(A) The features recited in claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 are novel and non-obvious over Zangi in view of Ketchum

The Office Action rejected claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 as being allegedly unpatentable as obvious over Zangi in view of Ketchum. The Office Action alleged that Zangi discloses every element recited in these claims with the exception of disclosing that the apparatus in Zangi is a multiple-input, multiple-output (MIMO) system having a plurality of signal receivers where concurrent interference and prefilter operation can be performed for a plurality of signals received through the signal receivers. The Office Action alleged that Ketchum cures the deficiencies of Zangi. Appellant respectfully submits that claims 21, 23-26, 28, 30-33, 36, 38, 40-42, 46, and 47 recite subject matter that is neither disclosed nor suggested in Zangi in view of Ketchum. Appellant respectfully

traverses this rejection and requests that it be reversed with respect to each claim.

(1) Claim 21

Appellant respectfully submits that Zangi in view of Ketchum fails to disclose or suggest every element recited in claim 21. Specifically, Zangi in view of Ketchum fails to disclose or suggest, at least,

> a decision feedback sequence estimator configured to receive the generated optimized values, wherein the decision feedback sequence estimator comprises a summing element, a feedback filter, and a maximum likelihood sequence estimator;
>
> a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system; and
>
> wherein an interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system,

as recited in claim 21. Contrary to the allegations presented in the Office Action, Appellant respectfully submits that Zangi fails to disclose or suggest the decision feedback sequence estimator (DFSE) recited in claim 21.

The Office Action unreasonably and erroneously grouped the feedback filter 104, the summer 106, and the decision algorithm 108 of Zangi in such a way as to allege that Zangi discloses the "decision feedback sequence estimator" recited in claim 21 (*see* Office Action, page 5, "circuits (104, 106, and 108) [are] considered as the claimed "decision feedback sequence estimator" to receive the coefficients (optimized values), note input to

filter 104).

Zangi is directed to a method for computing a coefficient of a finite impulse response pre-filter applied prior to a decision algorithm in an equalizer having adjustable filter coefficients. Computations performed to compute the filter coefficients for a right half burst may be used to compute the prefilter for a left hand burst, reducing the number of computations. A square root-free algorithm may be used to solve the system of linear equations, reducing computational complexity (Zangi, col. 2, lines 8-39).

Zangi explicitly discloses an equalizer 100, which may be a decision feedback equalizer (DFE) or a DFSE equalizer. Equalizer 100 includes an equalization filter 101, *a decision algorithm 108*, and a processor 120. Equalization filter 101 includes a prefilter 102, *a feedback filter 104*, and *a summer 106*. Processor 120 includes a channel estimator 122 and an adaptive algorithm 124 (Zangi, Figures 1 and 3; col. 3, line 29, to col. 4, line 60). Thus, equalizer 100, which Zangi explicitly discloses as a DFSE, includes a feedback filter 104, a summer 106, and a decision algorithm 108, *i.e.*, all three structural elements are contained *within* the DFSE 100 (*see* Zangi, Figure 3). Zangi further explicitly discloses that *DFSE 100 includes the pre-filter 102, the channel estimator 122, and the adaptive algorithm 124*, *i.e.*, the pre-filter 102, the channel estimator 122, and the adaptive algorithm 124 are also contained *within* the DFSE 100. Accordingly, one of ordinary skill in the relevant art would have understood that the DFSE 100 is not "configured to receive the generated optimized values" (emphasis added), rather, the optimized values are generated *within* the DFSE 100. DFSE 100 only receives the "received sequence, *r(k)*."

Further, Appellant respectfully submits that the Office Action unreasonably and erroneously re-grouped the elements of the DFSE 100 of Zangi to exclude the processor 120, so that the "optimized values" generated within the adaptive algorithm 124 could be received within the newly grouped DFSE (only including the feedback filter 104, the summer 106, and the decision algorithm 108). As previously discussed, Zangi explicitly describes that the DFSE *includes* the processor 120, the channel estimator 122, and the adaptive algorithm 124, and therefore the optimized values are generated *within* the DFSE 100, not *received* by the DFSE 100.

As acknowledged in the Office Action, Zangi also fails to disclose or suggest the features for the MIMO system recited in claim 21. Certain embodiments of the invention provide non-obvious advantages. Specifically, certain embodiments of the invention relate to a MIMO communication system, whereby interference cancellation and equalization pre-filtering operations at a receiving station of the MIMO communication system are performed. Hence, the system includes a joint encoder, a MIMO transmission, and a MIMO receiver.

Appellant respectfully submits that the Office Action unreasonably and erroneously combined Zangi with Ketchum to allege that Zangi in view of Ketchum discloses the features for the MIMO system recited in claims 21.

Ketchum is directed to a time-domain transmit and receive processing with channel eigenmode decomposition for MIMO systems. Ketchum discusses techniques for processing a data transmission at a transmitter and receiver. A time-domain

implementation is provided in Ketchum that uses frequency-domain singular value decomposition and "water-pouring" results to derive time-domain pulse-shaping and beam-steering solutions at the transmitter and receiver. The singular value decomposition is performed at the transmitter to determine eigenmodes (*e.g.*, spatial subchannels) of a MIMO channel and to derive a first set of steering vectors used to "precondition" the received signals so that orthogonal symbol streams are recovered at the receiver. Water-pouring analysis is used to more optimally allocate the total available transmit power to the eigenmodes, which then determines the data rate and the coding and modulation scheme to be used for each eigenmode (Ketchum, col. 2, line 25, to col. 3, line 10).

One of ordinary skill in the relevant art would not have found it obvious to combine Zangi with Ketchum. The Office Action alleged that it would have been obvious to combine Zangi and Ketchum to improve signal detection since the system would have been able to be configured to receive multiple copies so that existence of signal error can be easily determined (*see* Office Action on page 6). Appellant respectfully disagrees with the allegations presented in the Office Action.

One of ordinary skill in the relevant art would have understood that the fundamental differences between the features for the system discussed in Ketchum and the features of the system discussed in Zangi would have made it non-obvious to combine Zangi and Ketchum. For example, Ketchum discusses applying singular value decomposition (SVD) to derive time-domain *pulse-shaping* and *beam steering* solutions at a transmitter.

Additionally, Ketchum discusses the application of the SVD at the receiver to restore orthogonality (*see*, for example, the abstract of Ketchum) of the orthogonal symbol streams. Embodiments of the invention are not directed, nor require, *pulse-shaping*, *beam steering*, or orthogonal symbol streams. One would have concluded that these fundamental differences between Zangi and Ketchum demonstrate that a combination of Zangi and Ketchum would not have been obvious. Furthermore, one of ordinary skill in the relevant art would have understood that such a combination of Zangi and Ketchum would render Zangi unsatisfactory for its intended purpose.

However, assuming *arguendo* that Zangi could be combined with Ketchum, Zangi in view of Ketchum fails to disclose or suggest the DFSE recited in claim 21. As previously discussed, Zangi fails to disclose the features of the DFSE recited in claim 21. Ketchum fails to cure the deficiencies of Zangi. Ketchum makes no mention of a "decision feedback sequence estimator configured to receive the generated optimized values, wherein the decision feedback sequence estimator comprises a summing element, a feedback filter, and a maximum likelihood sequence estimator," as recited in claim 21. Accordingly, Appellant respectfully submits that the Office Action failed to substantiate a *prima facie* case of obviousness to demonstrate that Zangi in view of Ketchum discloses every element recited in claim 21. Appellant respectfully requests reconsideration and withdrawal of the rejection of claim 21.

(2) Claim 23

Claim 23 depends from, and further limits, claim 21. Claim 23 recites, in part, "wherein the maximum likelihood sequence estimator is configured to transmit generated maximum-likelihood values through an output to the feedback filter, and wherein an input of the maximum likelihood sequence estimator is configured to receive summed values from the summing element."

With respect to the rejection of claim 23 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 23. Thus, claim 23 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 23 under 35 U.S.C. §103(a).

(3) Claim 24

Claim 24 depends from claim 23, which further limits claim 21. Claim 24 recites, in part, "wherein the feedback filter comprises a first input configured to receive the optimized values from the signal optimizer and a second input configured to receive the generated maximum-likelihood values from the maximum likelihood sequence estimator."

With respect to the rejection of claim 24 under 35 U.S.C. §103(a), because Zangi in

view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 24. Thus, claim 24 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 24 under 35 U.S.C. §103(a).

(4) Claim 25

Claim 25 depends from claim 24, which further limits claim 21. Claim 25 recites, in part, "wherein the summing element is further configured to receive inputs from the prefilter and the feedback filter and is further configured to send a summed output to the maximum likelihood sequence estimator."

With respect to the rejection of claim 25 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 25. Thus, claim 25 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 25 under 35 U.S.C. §103(a).

(5) Claim 26

Like claim 23, claim 26 depends from, and further limits, claim 21. Claim 26 recites, in part, "wherein the prefilter comprises a feed forward filter."

With respect to the rejection of claim 26 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 26. Thus, claim 26 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 26 under 35 U.S.C. §103(a).

(6) Claim 28

Claim 28 depends from claim 24, which further limits claim 21. Claim 28 recites, in part, "wherein the feedback filter is further configured to receive the optimized signals from the signal optimizer that are used to define filter characteristics of the feedback filter."

With respect to the rejection of claim 28 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 28. Thus, claim 28 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not

disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 28 under 35 U.S.C. §103(a).

(7) Claim 30

Like claims 23 and 26, claim 30 depends from, and further limits, claim 21. Claim 30 recites, in part, "wherein the signal filter and the signal estimator comprise a receive chain."

With respect to the rejection of claim 30 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 30. Thus, claim 30 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 30 under 35 U.S.C. §103(a).

(8) Claim 31

Claim 31 depends from claim 30, which further limits claim 21. Claim 31 recites, in part, "wherein the apparatus comprises a plurality of receive chains corresponding to a plurality of signal receivers configured to receive and transmit a plurality of signal data

vectors to the plurality of receive chains."

With respect to the rejection of claim 31 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 31. Thus, claim 31 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 31 under 35 U.S.C. §103(a).

(9) Claim 46

Like claims 23, 26, and 30, claim 46 depends from, and further limits, claim 21. Claim 46 recites, in part, "wherein the apparatus is a mobile communications device."

With respect to the rejection of claim 46 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 46. Thus, claim 46 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 46 under 35 U.S.C. §103(a).

(10) Claim 47

Like claims 23, 26, 30, and 46, claim 47 depends from, and further limits, claim 21. Claim 47 recites, in part, "wherein the apparatus is an integrated circuit."

With respect to the rejection of claim 47 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the DFSE and the MIMO system recited in claim 21, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 47. Thus, claim 47 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 47 under 35 U.S.C. §103(a).

(11) Claim 32

Claim 32 recites, in part, "receiving a data vector at a receiving station of a multiple-input, multiple-output system … wherein receiving the data vector comprises receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system."

Despite the Office Action's allegations to the contrary, these features are not disclosed or suggested in Zangi in view of Ketchum. Similar features were discussed above with respect to claim 21. Therefore, for similar reasons noted above for claim 21, Appellant respectfully submits that the Office Action failed to substantiate a *prima facie*

case of obviousness to demonstrate that Zangi in view of Ketchum discloses every element recited in claim 32.

The Office Action failed to demonstrate that the features recited in claim 32 are obvious under 35 U.S.C. §103(a) based on Zangi in view of Ketchum. Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejection of claim 32.

(12) Claim 33

Claim 33 depends from, and further limits, claim 32. Claim 33 recites, in part, "wherein simultaneously performing interference cancellation and pre-filtering operations comprises filtering the data vector with the feed forward filter and transmitting a feed forward filter output to a summing element; receiving an output of the summing element in a maximum likelihood sequence estimator and generating an output that is transmitted to an input of the feedback filter and to a subsequent component; and filtering the output received from the maximum likelihood sequence estimator in the feedback filter and transmitting a filtered signal to the summing element."

With respect to the rejection of claim 33 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest the steps of the method recited in claim 32, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 33. Thus, claim 33 is patentable for at least the reasons that claim 32 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 33 under 35 U.S.C. §103(a).

(13) Claim 36

Claim 36 depends from, and further limits, claim 32. Claim 36 recites, in part, "wherein the receiving is conducted by a receiving filter in communication with a signal receiver; and wherein the forming the optimized feed forward filter parameters and the forming the optimized feedback filter parameters are conducted by a channel estimator in communication with the receiving filter, the channel estimator being in communication with an optimizer configured to generate the optimized feed forward filter parameters and the optimized feedback filter parameters."

With respect to the rejection of claim 36 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest the steps of the method recited in claim 32, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 36. Thus, claim 36 is patentable for at least the reasons that claim 32 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 36 under 35 U.S.C. §103(a).

(14) Claim 38

Claim 38 recites, in part,

> signal filtering means for filtering a signal from a signal receiver of a multiple-input, multiple-output system,
>
> wherein the interference cancelling means comprises summing means for summing inputs from the prefilter means; maximum likelihood sequence estimating means for generating maximum-likelihood values from the summing means; and feedback filtering means for filtering an output of the maximum likelihood sequence estimating means based on the generated optimized values to generate feedback-filtered values,
>
> wherein an interconnection of the prefiltering means, the feedback filtering means, the maximum likelihood sequence estimating means, and the summing means in the apparatus is configured to permit the concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system."

Despite the Office Action's allegations to the contrary, these features are not disclosed or suggested in Zangi in view of Ketchum. Similar features were discussed above with respect to claim 21. Therefore, for similar reasons noted above for claim 21, Appellant respectfully submits that the Office Action failed to substantiate a *prima facie* case of obviousness to demonstrate that Zangi in view of Ketchum discloses every element recited in claim 38.

The Office Action failed to demonstrate that the features recited in claim 38 are obvious under 35 U.S.C. §103(a) based on Zangi in view of Ketchum. Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejection of claim 38.

(15) Claim 40

Claim 40 depends from, and further limits, claim 38. Claim 40 recites, in part, "wherein the maximum likelihood sequence estimating means is further for transmitting the generated maximum-likelihood values through an output to the feedback filtering means, and wherein an input of the maximum likelihood sequence estimating means is further for receiving summed values from the summing means."

With respect to the rejection of claim 40 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the interference cancelling means and the MIMO system recited in claim 38, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 40. Thus, claim 40 is patentable for at least the reasons that claim 38 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 40 under 35 U.S.C. §103(a).

(16) Claim 41

Claim 41 depends from claim 40, which further limits claim 38. Claim 41 recites, in part, "wherein the feedback filtering means comprises a first input configured to receive the optimized values from the signal optimizing means and a second input configured to receive the generated maximum-likelihood values from the maximum likelihood sequence estimating means."

With respect to the rejection of claim 41 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the interference cancelling means and the MIMO system recited in claim 38, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 41. Thus, claim 41 is patentable for at least the reasons that claim 38 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 41 under 35 U.S.C. §103(a).

(17) Claim 42

Claim 42 depends from claim 41, which further limits claim 38. Claim 42 recites, in part, "wherein the summing means is further for receiving inputs from the prefiltering means and the feedback filtering means and is further for sending a summed output to the maximum likelihood sequence estimating means, an output of the maximum likelihood sequence estimating means being an output from the apparatus."

With respect to the rejection of claim 42 under 35 U.S.C. §103(a), because Zangi in view of Ketchum fails to disclose or suggest, at least, the interference cancelling means and the MIMO system recited in claim 38, Zangi in view of Ketchum also fails to disclose or suggest every element recited in dependent claim 42. Thus, claim 42 is patentable for at least the reasons that claim 38 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 42 under 35 U.S.C. §103(a).

(B) The features recited in claims 27 and 37 are novel and non-obvious over Zangi in view of Ketchum and Taylor

(1) Claim 27

Claim 27 depends from claim 25, which further limits claim 21. Claim 27 recites, in part, "a de-interleaver configured to de-interleave the signal from an output of the maximum likelihood sequence estimator; a de-punctuator configured to de-puncture the signal from the de-interleaver; and a channel decoder configured to decode the signal from the de-interleaver."

As previously discussed, Zangi in view of Ketchum fails to disclose or suggest every element recited in claim 21. Taylor fails to cure the deficiencies of Zangi and Ketchum. Taylor is directed to a transparent data transmission for a wireless/cellular communication system. An analog signal from a modem or other source is converted at a remote station to a digital bit stream in accordance with a memoryless compaction rule. The resultant bit stream is then transmitted through a transparent channel that includes a wireless cellular-telephone link. At the base station, that bit stream is transmitted over a public-switched-network span (Taylor, para. [0003]-[0005]). Taylor fails to disclose or suggest the DFSE and the MIMO system recited in claim 21. Accordingly, Zangi in view of Ketchum and Taylor fails to disclose or suggest every element recited in claim 21, and

therefore also fails to disclose or suggest every element recited in dependent claim 27. Thus, claim 27 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum and Taylor.

Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 27 under 35 U.S.C. §103(a).

(2) Claim 37

Claim 37 depends from claim 33, which further limits claim 32. Claim 37 recites, in part, "wherein the subsequent component comprises a de-interleaver, a de-punctuator, and a channel decoder."

As previously discussed, Zangi in view of Ketchum fails to disclose or suggest every element recited in claim 32. Taylor fails to cure the deficiencies of Zangi and Ketchum. Taylor fails to disclose or suggest the steps of the method recited in claim 32. Accordingly, Zangi in view of Ketchum and Taylor fails to disclose or suggest every element recited in claim 32, and therefore also fails to disclose or suggest every element recited in dependent claim 37. Thus, claim 37 is patentable for at least the reasons that claim 21 is patentable, and further, because it recites additional limitations that are not disclosed in Zangi in view of Ketchum and Taylor. Accordingly, Appellant respectfully requests reconsideration and withdrawal of the rejections of claim 37 under 35 U.S.C. §103(a).

For all of the above noted reasons, it is strongly contended that certain clear

differences exist between the present invention as claimed in claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47, and the prior art relied upon by the Examiner. It is further contended that these differences are more than sufficient that the present invention would not have been obvious to a person having ordinary skill in the relevant art at the time the invention was made.

These final rejections being in error, therefore, it is respectfully requested that this honorable Board of Patent Appeals and Interferences reverse the Examiner's decision in this case and indicate the allowability of application claims 21, 23-28, 30-33, 36-38, 40-42, 46, and 47.

In the event that this paper is not being timely filed, Appellant respectfully petitions for an appropriate extension of time. Any fees for such an extension together with any additional fees which may be due with respect to this paper may be charged to Counsel's Deposit Account 50-2222.

Respectfully submitted,

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Encls: Appendix 1 - Claims on Appeal
Appendix 2 - Evidence
Appendix 3 - Related Proceedings

APPENDIX 1

CLAIMS ON APPEAL

1-20. (Cancelled)

21. (Previously Presented) An apparatus, comprising:

a signal filter configured to filter a signal from a signal receiver of a multiple-input, multiple-output system;

a signal estimator configured to estimate channel operations of the signal from the signal filter;

a signal optimizer configured to generate optimized values for the signal from the signal filter;

a prefilter configured to filter the signal from the signal filter using the generated optimized values for the signal; and

a decision feedback sequence estimator configured to receive the generated optimized values, wherein the decision feedback sequence estimator comprises a summing element, a feedback filter, and a maximum likelihood sequence estimator,

wherein the summing element, the feedback filter, and the maximum likelihood sequence estimator are operatively connected to one another and further operatively connected to the prefilter,

wherein an interconnection of the prefilter, the feedback filter, the maximum likelihood sequence estimator, and the summing element in the apparatus is configured to

permit concurrent interference and prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system.

22. (Cancelled)

23. (Previously Presented) The apparatus of claim 21, wherein the maximum likelihood sequence estimator is configured to transmit generated maximum-likelihood values through an output to the feedback filter, and wherein an input of the maximum likelihood sequence estimator is configured to receive summed values from the summing element.

24. (Previously Presented) The apparatus of claim 23, wherein the feedback filter comprises a first input configured to receive the optimized values from the signal optimizer and a second input configured to receive the generated maximum-likelihood values from the maximum likelihood sequence estimator.

25. (Previously Presented) The apparatus of claim 24, wherein the summing element is further configured to receive inputs from the prefilter and the feedback filter and is further configured to send a summed output to the maximum likelihood sequence estimator.

26. (Previously Presented) The apparatus of claim 21, wherein the prefilter comprises a feed forward filter.

27. (Previously Presented) The apparatus of claim 25, further comprising:

a de-interleaver configured to de-interleave the signal from an output of the maximum likelihood sequence estimator;

a de-punctuator configured to de-puncture the signal from the de-interleaver; and

a channel decoder configured to decode the signal from the de-interleaver.

28. (Previously Presented) The apparatus of claim 24, wherein the feedback filter is further configured to receive the optimized signals from the signal optimizer that are used to define filter characteristics of the feedback filter.

29. (Cancelled)

30. (Previously Presented) The apparatus of claim 21, wherein the signal filter and the signal estimator comprise a receive chain.

31. (Previously Presented) The apparatus of claim 30, wherein the apparatus comprises a plurality of receive chains corresponding to a plurality of signal receivers configured to receive and transmit a plurality of signal data vectors to the plurality of

receive chains.

32. (Previously Presented) A method, comprising:

receiving a data vector at a receiving station of a multiple-input, multiple-output system;

forming optimized feed forward filter parameters from the data vector;

forming optimized feedback filter parameters from the data vector;

transmitting the optimized feed forward filter parameters and the optimized feedback filter parameters to a decision feedback sequence estimator, wherein the decision feedback sequence estimator comprises a feedback filter;

applying the optimized feed forward filter parameters to a feed forward filter to define filter characteristics of the feed forward filter;

applying the optimized feedback filter parameters to the feedback filter to define filter characteristics of the feedback filter; and

simultaneously performing interference cancellation and pre-filtering operations on the data vector through operation of the feed forward and feedback filters,

wherein receiving the data vector comprises receiving a plurality of data vectors on a corresponding plurality of receiving chains at the receiving station of the multiple-input, multiple-output system.

33. (Previously Presented) The method of claim 32, wherein simultaneously

performing interference cancellation and pre-filtering operations comprises:

filtering the data vector with the feed forward filter and transmitting a feed forward filter output to a summing element;

receiving an output of the summing element in a maximum likelihood sequence estimator and generating an output that is transmitted to an input of the feedback filter and to a subsequent component; and

filtering the output received from the maximum likelihood sequence estimator in the feedback filter and transmitting a filtered signal to the summing element.

34-35. (Cancelled)

36. (Previously Presented) The method of claim 32, wherein the receiving is conducted by a receiving filter in communication with a signal receiver; and wherein the forming the optimized feed forward filter parameters and the forming the optimized feedback filter parameters are conducted by a channel estimator in communication with the receiving filter, the channel estimator being in communication with an optimizer configured to generate the optimized feed forward filter parameters and the optimized feedback filter parameters.

37. (Previously Presented) The method of claim 33, wherein the subsequent component comprises a de-interleaver, a de-punctuator, and a channel decoder.

38. (Previously Presented) An apparatus, comprising:

signal filtering means for filtering a signal from a signal receiver of a multiple-input, multiple-output system;

signal estimating means for estimating channel operations of the signal from the signal filtering means;

signal optimizing means for generating optimized values for the signal from the signal filtering means;

prefiltering means for filtering the signal from the signal filtering means using the generated optimized values for the signal; and

interference cancelling means for receiving the generated optimized values to perform concurrent interference and prefilter operations,

wherein the interference cancelling means comprises

summing means for summing inputs from the prefilter means;

maximum likelihood sequence estimating means for generating maximum-likelihood values from the summing means; and

feedback filtering means for filtering an output of the maximum likelihood sequence estimating means based on the generated optimized values to generate feedback-filtered values,

wherein an interconnection of the prefiltering means, the feedback filtering means, the maximum likelihood sequence estimating means, and the summing means in the apparatus is configured to permit the concurrent interference and

prefilter operations to be performed for a plurality of signals received by a plurality of signal receivers in the multiple-input, multiple-output system.

39. (Cancelled)

40. (Previously Presented) The apparatus of claim 38, wherein the maximum likelihood sequence estimating means is further for transmitting the generated maximum-likelihood values through an output to the feedback filtering means, and wherein an input of the maximum likelihood sequence estimating means is further for receiving summed values from the summing means.

41. (Previously Presented) The apparatus of claim 40, wherein the feedback filtering means comprises a first input configured to receive the optimized values from the signal optimizing means and a second input configured to receive the generated maximum-likelihood values from the maximum likelihood sequence estimating means.

42. (Previously Presented) The apparatus of claim 41, wherein the summing means is further for receiving inputs from the prefiltering means and the feedback filtering means and is further for sending a summed output to the maximum likelihood sequence estimating means, an output of the maximum likelihood sequence estimating means being an output from the apparatus.

43-45. (Cancelled)

46. (Previously Presented) The apparatus of claim 21, wherein the apparatus is a mobile communications device.

47. (Previously Presented) The apparatus of claim 21, wherein the apparatus is an integrated circuit.

APPENDIX 2

EVIDENCE APPENDIX

No evidence under section 37 C.F.R. §§1.130, 1.131, or 1.132 has been entered or will be relied upon by Appellant in this appeal.

APPENDIX 3

RELATED PROCEEDINGS APPENDIX

No decisions of the Board or of any court have been identified under 37 C.F.R. §41.37(c)(1)(ii).

On May 12, 2010, Appellant petitioned the Commissioner for Patents under 37 C.F.R. § 1.182 for withdrawal of the objections to the drawings presented in the Final Office Action dated February 16, 2010 and the Advisory Action dated April 9, 2010.

In the Office Action dated February 16, 2010, Figures 1-3 were objected under 37 C.F.R. §1.83(a) (*see* Office Action, paragraph 2). The Office Action alleged that the specification failed to provide support for various features shown in Figures 1-3. Appellant's petition traversed each of the drawing objections presented in the Office Action.

Appellant's petition is pending before the Commissioner.